ALASKA POLLUTANT DISCHARGE ELIMINATION SYSTEM

PERMIT FACT SHEET

Permit Number: AK0053643

Fort Knox Mine

DEPARTMENT OF ENVIRONMENTAL CONSERVATION

Wastewater Discharge Authorization Program

555 Cordova Street

Anchorage, AK 99501

Public Comment Period Start: March 23, 2018
Public Comment Period End: April 23, 2018
Alaska Online Public Notice System

Technical Contact: Tim Pilon
Alaska Department of Environmental Conservation
Division of Water
Wastewater Discharge Authorization Program
610 University Avenue
Fairbanks, AK 99709-3643
(907) 451-2136
Fax: (907) 451-2187
tim.pilon@alaska.gov

An Alaska Pollutant Discharge Elimination System (APDES) permit is issued to

FAIRBANKS GOLD MINING, INCORPORATED

For wastewater discharges from

Fort Knox Mine
1 Fort Knox Road
Fairbanks, Alaska 99712

The Alaska Department of Environmental Conservation (Department or DEC) issues an APDES individual permit (permit) to Fairbanks Gold Mining, Incorporated (FGMI). The permit authorizes and sets conditions on the discharge of pollutants from this facility to waters of the United States. In order to ensure protection of water quality and human health, the permit places limits on the types and amounts of pollutants that can be discharged from the facility and outlines best management practices to which the facility must adhere.

This fact sheet explains the nature of potential discharges from the Fort Knox Mine and the development of the permit including:

- information on public comment, public hearing, and appeal procedures,
- a listing of effluent limits and other conditions,
- technical material supporting the conditions in the permit, and
- monitoring requirements in the permit.

Appeals Process

The Department has both an informal review process and a formal administrative appeal process for final APDES permit decisions. An informal review request must be delivered within 15 days after receiving the Department's decision to the Director of the Division of Water at the following address:

Director, Division of Water
Alaska Department of Environmental Conservation
555 Cordova Street
Anchorage, AK 99501

Interested persons can review 18 AAC 15.185 for the procedures and substantive requirements regarding a request for an informal Department review.

See http://www.dec.state.ak.us/commish/InformalReviews.htm for information regarding informal reviews of Department decisions.

An adjudicatory hearing request must be delivered to the Commissioner of the Department within 30 days of the permit decision or a decision issued under the informal review process. An adjudicatory hearing will be conducted by an administrative law judge in the Office of Administrative Hearings within the Department of Administration. A written request for an adjudicatory hearing shall be delivered to the Commissioner at the following address:

Commissioner
Alaska Department of Environmental Conservation
410 Willoughby Avenue, Suite 303
Juneau AK, 99801

Interested persons can review 18 AAC 15.200 for the procedures and substantive requirements regarding a request for an adjudicatory hearing. See http://www.dec.state.ak.us/commish/ReviewGuidance.htm for information regarding appeals of Department decisions.

Documents are Available

The permit, fact sheet, and other information are located on the Department's Wastewater Discharge Authorization Program website: http://www.dec.state.ak.us/water/wwdp/index.htm. The permit, fact sheet, response to comments, and related documents can also be obtained by visiting or contacting DEC between 8:00 a.m. and 4:30 p.m. Monday through Friday at the addresses below.

Alaska Department of Environmental Conservation Division of Water Wastewater Discharge Authorization Program	
Fairbanks Office 610 University Ave. Fairbanks, AK 99709 (907) 451-2136	***Anchorage Office*** 555 Cordova Street Anchorage, AK 99501 (907) 269-6285

TABLE OF CONTENTS

LIST OF TABLES

TABLE OF FIGURES

LIST OF APPENDICES

1.0 APPLICANT

This fact sheet provides information on the Alaska Pollutant Discharge Elimination System (APDES) permit for the following entity.

Applicant	Fairbanks Gold Mining, Incorporated (FGMI)
Facility Name	Fort Knox Mine (Fort Knox)
APDES Permit Number	AK0053643
Facility Location	1 Fort Knox Road Fairbanks, Alaska 99712
Mailing Address	P.O. Box 73726 Fairbanks, Alaska 99707-3726
Facility Contact	Ms. Bartly Kleven, Environmental Manager (907) 490-2207

The map in Figure 2 and photos in Figure 3 to this fact sheet show the location of the discharge points to the Old Fish Creek Channel and the North Channel.

2.0 FACILITY INFORMATION

2.1 Background

This fact sheet provides the basis for the conditions and requirements of APDES permit AK0053643 authorizing the discharge of pollutants from outfalls 001 and 002 to the Old Fish Creek Channel and North Channel, respectively. Pollutants generated at the facility result from mine drainage and facility processes, waste streams, and operations. For outfall 001, the system is designed to directly discharge reverse osmosis (RO) permeate or to mix treated wastewater with clean dewatering well groundwater before discharge. Outfall 002 is new and discharges RO treated mine drainage and process water. This permit action marks the first reissuance of the original APDES permit issued in 2012 and includes effluent limits and monitoring requirements for discharges to the Old Fish Creek Channel and North Channel.

Fort Knox is owned and operated by FGMI, a wholly-owned subsidiary of Kinross Gold Corporation. Fort Knox, originally permitted for construction and operation in 1994, is an open-pit gold mine located approximately 26 miles northeast of Fairbanks on the north flank of Gilmore Dome. The mine is located along a belt of lode and placer deposits that comprise one of the highest gold-producing areas in Alaska. The area in and around Fort Knox has a long history of gold exploration and mining activities, dating back almost 100 years; the drainages surrounding Fort Knox were first prospected in 1913 (USGS 2001). Fort Knox processes ore onsite at a carbon-in-pulp mill with a daily capacity of up to 45,000 tons and produces approximately 300,000 to 350,000 ounces of gold annually. Site facilities include the active open pit mine, mill, tailings storage facility (TSF), constructed wetlands complex, freshwater reservoir, and the Walter Creek Valley heap leach facility. See the three figures on pages 20 to 22 for Fort Knox location and site maps.

2.2 Active Open Pit Mine

The active open pit mine is located in the southwestern portion of Fort Knox. Mining

operations are conducted 24 hours a day, seven days a week. The pit is actively dewatered via a system of dewatering wells, which continuously pump groundwater from beneath the pit and its surrounding area to maintain dry conditions.

2.3 Tailings Storage Facility

The TSF consists of deposited tailings, decant pond, dam, seepage interception system, and the seepage monitoring system. The TSF decant pond is located within the tailings deposition area upstream of the TSF dam. The TSF decant pond fluctuates in size but typically ranges between 300 to 400 acres depending on mine operations and climatic influences.

The TSF dam is an earth-filled structure approximately 4,500 feet long and 421 feet high at its crest. It impounds all tailings generated by the mill, as well as surface runoff and process water. The dam is designed and maintained to contain the 100-year, 24-hour storm event in addition to the average 30-day spring breakup. Impoundment water is not discharged but is recycled to the mill for reuse in the gold ore beneficiation process.

The TSF dam is designed to allow seepage to pass beneath the dam into fractured bedrock. All seepage is then captured by pump-back and interceptor systems. The pump-back system includes a pump-back sump together with a pumping and piping system designed to return the seepage to the TSF. Most seepage passing beneath the dam feeds into a large lined sump from which the seepage is pumped back to the decant pond at a rate of approximately 2,000 gallons per minute (gpm). Any seepage not captured directly by the pump-back system is captured by interceptor wells, which create a hydraulic barrier preventing seepage from migrating downgradient. The permit allows the discharge of TSF seepage after treatment.

2.4 Constructed Wetlands Complex

The Old Fish Creek Channel originated in the area currently occupied by the TSF. Consequently, remnants of the Old Fish Creek Channel are first evident downgradient from the toe of the TSF dam, and water flows east through a series of constructed wetlands and ponds (Ponds A through F) moving east toward the reservoir. Ponds A and B are adjacent to one another, with a north-south bifurcation in their center. Pond A is fed from the west and Pond B is fed from the north through a culvert. Water outflows from Ponds A and B through a low-flow channel draining to the east and under the road. Flow continues downstream, into the freshwater reservoir. With the exception of high precipitation events and the discharge of treated wastewater, the Old Fish Creek Channel and North Channel are dry.

Ponds C, D, E, and F are hydraulically separated from Ponds A and B and the Old Fish Creek Channel. Ponds C, D, E, and F receive much of their water volume from an unnamed creek to the south that flows eastward from Pond C through D, E, and F before entering the Old Fish Creek Channel which then flows into the freshwater reservoir.

The constructed wetlands complex, upstream to Pond D, provides favorable spawning and overwintering habitat for resident fish species.

The North Channel is an existing channel. It carries discharge from outfall 002 past Pond A on the north and into the west end of Pond B. Flow exits Pond B on its northeast end via the Old Fish Creek Channel.

2.5 Freshwater Reservoir

The freshwater reservoir is located on Fish Creek three miles below the TSF dam. The reservoir receives inflows through precipitation and runoff from surrounding drainages (i.e., Last Chance Creek and Solo Creek), as well as the Old Fish Creek Channel, upstream of the reservoir. A spillway on the downstream end of the freshwater reservoir releases water into a lower reach of Fish Creek. The reservoir supports self-sustaining populations of Arctic grayling and burbot. Water from the reservoir is supplied to the mill for mixing reagents, gland water, and makeup water for the milling process when necessary.

2.6 Wastewater Management

With the exception of treated wastewater discharged from outfalls 001 and 002, Fort Knox operates the TSF as a zero-discharge facility. Water from mining, processing, mill operations, and pit dewatering is routed to the TSF for reuse in mine operations. Wastewater consisting of seepage beneath the TSF dam captured by seepage pump-back and interceptor systems, TSF decant, mine drainage, and dewatering water is treated and discharged through outfalls 001 and 002. The freshwater reservoir receives inflows through precipitation and runoff from surrounding drainages (i.e. Last Chance Creek and Solo Creek), as well as the Old Fish Creek Channel, which receives flow from the North Channel, upstream of the reservoir.

2.7 Pollutants of Concern

Pollutants of concern were identified using Effluent Limitation Guidelines (ELGs) and water quality monitoring data for effluent and TSF water as provided by the applicant. See Appendix B for a detailed analysis of the pollutants of concern.

3.0 COMPLIANCE HISTORY

Discharge Monitoring Reports (DMRs) from October 2012 to December 2017 were reviewed to determine the facility's compliance with effluent limits.

Table 1: Outfall 001 Permit Limit Exceedances

Parameter	Date	Units	Monitoring		
			Basis	Permit Limit	Reported Value
cyanide	July 2016	µg/L[a]	Daily Maximum	4.3	46.5
cyanide	July 2016	µg/L[a]	Monthly Average	8.5	11.6
a. Micrograms per liter					

A July 20, 2016 RO effluent sample resulted in a cyanide measurement of 46.5 µg/L. However, the preceding sample on July 13, 2016 and the subsequent sample on July 27, 2016 resulted in non-detect measurements, below the method detection limit of 3 µg/L. The single high daily measurement caused an exceedance of the monthly average. Mitigating steps were taken including discontinuing discharge of RO effluent. Since the single upset event, no other exceedances have occurred.

4.0 EFFLUENT LIMITS AND MONITORING REQUIREMENTS

4.1 Basis for Permit Effluent Limits

The Clean Water Act (CWA) requires that the limits for a particular pollutant be the more stringent of either technology-based effluent limits (TBELs) or water quality-based effluent limits (WQBELs). TBELs are set according to the level of treatment that is achievable using available technology. A WQBEL is designed to ensure that the Water Quality Standards (WQS) of a waterbody are met and may be more stringent than TBELs. Both the TBELs included in 40 CFR § 440 (adopted by reference in 18 AAC 83.010) and WQBELs are included in the permit. A detailed discussion of the basis for the effluent limits contained in the permit is provided in Appendix B.

Outfalls 001 and 002 discharge mine drainage and contact water from the mine site. EPA promulgated ELGs for the ore mining and dressing point source category at 40 CFR Part 440, which include TBELs for this point source category. Subpart J is applicable to the Copper, Lead, Zinc, Gold, Silver, and Molybdenum Ores Subcategory. The ELGs in Subpart J are applicable to outfalls 001 and 002.

Discharges at outfalls 001 and 002 are subject to the new source performance standards at 40 CFR § 440.104(a). These ELGs are applicable to a source that commenced construction after December 3, 1982. Table 2 identifies TBELs for outfalls 001 and 002.

Table 2: Technology-Based Effluent Limits for Outfalls 001 and 002

Parameter	Units	Maximum for any 1 day	Average of daily values for 30 consecutive days	Range
cadmium	mg/L	0.10	0.05	-
copper	mg/L	0.30	0.15	-
lead	mg/L	0.6	0.3	-
mercury	mg/L	0.002	0.001	-
zinc	mg/L	1.5	0.75	-
pH	s.u.[a]	-	-	6.0-9.0
total suspended solids (TSS)	mg/L	30.0	20.0	-

a. Standard units

4.2 Basis for Effluent Limits and Monitoring Requirements

In accordance with AS 46.03.110(d), the Department may specify in a permit the terms and conditions under which waste material may be disposed. Monitoring in a permit is required to determine compliance with effluent limits. Monitoring may also be required to gather effluent and receiving water data to determine if additional effluent limits are required or to monitor effluent impact on the receiving waterbody quality. The Permittee is responsible for conducting the monitoring and for reporting results on DMRs or on the application for reissuance, as appropriate, to the Department. Fact Sheet Sections 4.3 and 4.4 summarize monitoring requirements DEC has determined necessary to implement in the permit (additional discussion about the basis for monitoring requirements can be found in Appendix B).

4.3 Effluent Limits and Monitoring requirements

The permit contains effluent limits that are the most stringent of either TBELs or WQBELs and a flow limit based on average net precipitation falling on or running into the TSF. Monitoring frequencies are based on the nature and effect of a pollutant, as well as a determination of the minimum sampling necessary to adequately monitor the facility's performance. Permittees have the option of taking more frequent samples than are required under the permit. These samples must be included in calculations and used for averaging if they are conducted using the Department-approved, significantly sensitive test methods (generally found in 18 AAC 70 and 40 CFR Part 136 [adopted by reference in 18 AAC 83.010(f)]) and if the minimum levels of quantification are less than the effluent limits.

Table 3 summarizes the effluent limits and monitoring requirements for outfalls 001 and 002, and it provides a comparison to the limits in the previous permit. Please see Appendix B for more details regarding the legal and technical basis surrounding the selection of effluent limits.

Table 3: Effluent Limits and Monitoring Frequencies for Outfalls 001 and 002 (Changes in Boldface)

Parameter[a] (µg/L unless otherwise noted)	Daily Maximum		Monthly Average		Minimum Sample Frequency	
	2012 Permit	2018 Permit	2012 Permit	2018 Permit	2012 Permit	2018 Permit
antimony	12	**monitor**	6.0	**monitor**	1/week	**1/quarter**
arsenic	20	**monitor**	10	**monitor**	1/week	**1/quarter**
cadmium	NA[b]	**0.31**	NA	**0.15**	NA	1/week
chloride	NA	**monitor**	NA	**monitor**	NA	**1/quarter**
chromium	monitor	**NA**	monitor	**NA**	1/week	**NA**
copper	8.9	**8.7**	4.4	**3.1**	1/week	1/week
cyanide, WAD[c]	8.7	**8.7**	4.3	**2.8**	1/week	1/week
fluoride	2.0	**NA**	1.0	**NA**	1/week	**NA**
lead	2.8	**2.9**	1.4	**0.92**	1/week	1/week
manganese	100	**NA**	50	**NA**	1/week	**NA**
mercury	NA	**0.020**	NA	**0.010**	NA	1/week
nickel	57	**NA**	29	**NA**	1/week	**NA**
nitrite + nitrate as N (mg/L)	20	**monitor**	10	**monitor**	1/week	1/week
pH (s.u.)	Within the range of 6.5 to 8.5				1/week	1/week
sulfate (mg/L)	500	**monitor**	250	**monitor**	1/week	**1/quarter**
total dissolved solids (mg/L)	1,000	**NA**	500	**NA**	1/week	**NA**
total suspended solids (mg/L)	NA	**30**	NA	**20**	NA	**1/week**
volume, cumulative (gallons per year)	1.051 billion[d]	**3.164 billion[d]**	NA	NA	continuous	continuous
zinc	80	**78**	40	**26**	1/week	1/week
whole effluent toxicity (WET), TU_C[e]	monitor	monitor	NA	NA	annually	annually

a. Use the following test methods: EPA Method 200.8 for metals, Standard Method 4500 CN-I for WAD cyanide, and EPA Method 1631-E for mercury, and EPA Method 300.0 for anions.
b. Not applicable
c. Weak acid dissociable
d. An annual cumulative maximum and not a daily maximum
e. Chronic toxicity units

As required under 18 AAC 83.435, a reasonable potential analysis was conducted to determine if the effluent has reasonable potential to exceed Alaska WQS. An analysis of monitoring data showed that there is no reasonable potential to exceed WQS for aluminum, ammonia, antimony, arsenic, barium, chromium, fluoride, iron, manganese, nickel, nitrite plus nitrate as nitrogen, selenium, silver, sulfate, and total dissolved solids. The permit requires no limits or monitoring for aluminum, ammonia, barium, chromium, fluoride, iron, manganese, nickel, selenium, silver, and total dissolved solids. Since antimony, arsenic, chloride, nitrate and nitrate, and sulfate are pollutants of concern, quarterly monitoring was maintained for those constituents even though the limits were removed.

This permit authorizes the discharge of mine drainage where the previous permit did not. Consequently, TBELs apply to the effluent. That resulted in adding monitoring and limits for cadmium, mercury, and total suspended solids.

The cumulative flow limit, 3.164 billion gallons per year (6,016 gpm) was derived by using mine site meteorological, water quality, and TSF seepage pump-back data from 2012 through 2016 as provided by the applicant. Specifically, cumulative total is the sum of the average annual net precipitation falling on the treatment facility (4,268 gpm), average annual pit dewatering (1,568 gpm), and the annual average ambient groundwater portion from the TSF pump-back system (180 gpm).

Effluent limits must be developed for parameters that have a reasonable potential to exceed WQS. Analysis of recent data resulted in a number of changes to the effluent limits in the permit. Some limits have decreased, while other limits have increased. For parameters that did not demonstrate reasonable potential, limits or monitoring requirements may have been revised or removed as discussed in the preceding paragraph. The Department conducted the necessary antibacksliding analysis in Section 6.0, which is further examined in Section 7.0.

4.4 WET Monitoring

Under 18 AAC 83.435(e), a permit must contain limits on WET when a discharge has reasonable potential to cause or contribute to an exceedance of the WET numeric criterion, which is found in 18 AAC 70.030.

WET tests are laboratory tests that measure total toxic effect of an effluent on living organisms. WET tests use small vertebrate and invertebrate species and/or plants to measure the aggregate toxicity of an effluent. The two different durations of toxicity tests are acute and chronic. Acute toxicity tests measure survival over a 96-hour exposure. Chronic toxicity tests measure reductions in survival, growth, and reproduction over a 7-day exposure.

Since discharge recently began, only two WET sampling events, and two tests do not provide reasonable assurances on which to base any conclusions. Consequently, the permit

requires annual WET monitoring at each outfall to evaluate the potential aggregate toxicity of the effluent and to produce a set of ten data on which future WET requirements can be evaluated.

4.5 Electronic Discharge Monitoring Reports

4.5.1 E-Reporting Rule for DMRs (Phase I)

The permittee must submit monthly DMR data electronically through Network Discharge Monitoring Report (NetDMR) per Phase I of the E-Reporting Rule (40 CFR Part 127) upon the effective date of this permit. Authorized persons may access permit information by logging into the NetDMR Portal (https://cdxnodengn.epa.gov/oeca-netdmr-web/action/login). Permittees submitting DMRs in compliance with the E-Reporting Rule are not required to submit as described in permit Appendix A – Standard Conditions unless requested or approved by DEC. Permittees shall include any DMR data required by the permit that cannot be reported in a NetDMR field (e.g., mixing zone receiving water data, etc.) as an attachment to the NetDMR submittal. DEC has established an E-Reporting website at http://dec.alaska.gov/water/Compliance/EReportingRule.htm that contains general information about this new reporting format. Training materials and webinars for NetDMR can be found at https://netdmr.zendesk.com/home.

4.5.2 E-Reporting Rule for Other Reports (Phase II)

Phase II of the E-Reporting Rule will integrate electronic reporting for all other reports required by the permit (e.g., Annual Reports and Certifications), and implementation is expected to begin December 2020. The permittee should monitor DEC's E-Reporting website (http://dec.alaska.gov/water/Compliance/EReportingRule.htm) for updates on Phase II of the E-Reporting Rule and will be notified when required to begin submitting all other reports electronically. Until such time, other reports required by the permit may be submitted in accordance with permit Appendix A – Standard Conditions.

4.6 Annual Water Quality Monitoring Summary

Under 18 AAC 83.455(b), the Department establishes requirements to report monitoring results, including the frequency of required reports, on a case-by-case basis depending on the nature and effect of the discharge. The Department requires a monitoring report from a Permittee under this subsection at least once a year. An annual summary of water quality monitoring, as required in Permit Part 1.6, allows a comprehensive evaluation of water quality trends each year.

5.0 RECEIVING WATERBODY

5.1 Water Quality Standards

Regulations in 18 AAC 70 require that the conditions in permits ensure compliance with the WQS. The state's WQS are composed of use classifications, numeric and narrative water quality criteria, and an Antidegradation Policy. The use classification system designates the beneficial uses that each waterbody is required to achieve. The numeric and narrative water quality criteria are deemed necessary by the state to support the beneficial use classification of each waterbody. The Antidegradation Policy ensures that beneficial uses and existing water quality are maintained.

Waterbodies in Alaska are designated for all uses unless the water has been reclassified under 18 AAC 70.230 as listed under 18 AAC 70.230(e). Some waterbodies in Alaska can also have site–specific water quality criteria per 18 AAC 70.235, such as those listed under 18 AAC 70.236(b). The receiving water for the discharge, the Old Fish Creek Channel and the North Channel, have not been reclassified, nor have site-specific water quality criteria been established. Accordingly, the freshwater reservoir which receives flow from the Old Fish Creek Channel and North Channel is currently classified under 18 AAC 70.020 for protection of all freshwater uses Therefore, receiving waters, Old Fish Creek Channel, North Channel, and freshwater reservoir must be protected for all fresh water designated use classes listed in 18 AAC 70.020(a)(1), including:

1. domestic water supply – 18 AAC 70.020(b)(1)(A)(i)
2. agriculture water supply – 18 AAC 70.020(b)(1)(A)(ii)
3. aquaculture water supply – 18 AAC 70.020(b)(1)(A)(iii)
4. industrial uses – 18 AAC 70.020(b)(1)(A)(iv)
5. contact recreation – 18 AAC 70.020(b)(1)(B)(i)
6. secondary recreation – 18 AAC 70.020(b)(1)(B)(ii)
7. growth and propagation of fish, shellfish, other aquatic life, and wildlife – 18 AAC 70.020(b)(1)(C)

5.2 Water Quality Status of Receiving Waterbody

Any part of a waterbody for which the water quality does not or is not expected to meet applicable WQS is defined as a "water quality limited segment" and placed on the state's impaired waterbody list. The Old Fish Creek Channel, North Channel, and freshwater reservoir are not listed as impaired in the *Alaska Final 2010 Integrated Water Quality Monitoring and Assessment Report* (2010). Accordingly, no Total Maximum Daily Load (TMDL) has been prepared and implemented per Section 303(d) of the Clean Water Act for this receiving waterbody.

5.3 Receiving Water Monitoring

There is one receiving water monitoring station identified as the *Freshwater Reservoir Spillway*. Monitored parameters must be sampled at least every calendar quarter. To ensure protection of receiving water quality, Table 4 contains parameters that must be monitored in the freshwater reservoir downstream. Receiving water monitoring is required to verify that the designated uses of the affected water have been protected from the pollutants of concern.

Table 4: Receiving Water Monitoring Requirements

Parameter[a]	Units	Minimum Level of Quantification (ML)
cadmium	µg/L	0.5
copper	µg/L	3.1
cyanide, WAD	µg/L	10
lead	µg/L	1.4
mercury	µg/L	0.010

Parameter[a]	Units	Minimum Level of Quantification (ML)
nitrite + nitrate as N	mg/L	10
pH	s.u.	± 0.1
zinc	µg/L	78
hardness, calculated[b]	mg/L	-
pH	s.u.	4.0 to 11.0
a. Use the following test methods: EPA Method 200.8 for metals, Standard Method 4500 CN-I for WAD cyanide, and EPA Method 1631-E for mercury. b. Hardness is calculated as follows: (2.497 x [Ca]) + (4.118 x [Mg]).		

6.0 ANTIBACKSLIDING

Per 18 AAC 83.480(a), "Except as provided in (b) of the section, when a permit is renewed or reissued, interim effluent limitations, standards or conditions must be at least as stringent as the final effluent limitations, standards, or conditions in the previous permit, unless the circumstances on which the previous permit was based have materially and substantially changed since the permit was issued, and the change in circumstances would constitute cause for permit modification or revocation and reissuance under 18 AAC 83.135."

Effluent limitations may be relaxed as allowed under 18 AAC 83.480, CWA §402(o) and CWA §303(d)(4). 18 AAC 83.480(b) allows relaxed limitations in renewed, reissued, or modified permits when there have been material and substantial alterations or additions to the permitted facility or where new information is available that justifies the relaxation. Since the last permit was reissued, new information has been collected to characterize the effluent and determine limits.

CWA §402(o)(2)(B)(i) exempts antibacksliding provisions if information which was not available at the time of permit issuance and would have justified the application of a less stringent effluent limitation at the time of permit issuance. Outfall 001 was associated with certain limitations that are less stringent or removed (where no reasonable potential was indicated) based on the collection and statistical analysis of new effluent data, which satisfies the condition for the antibacksliding exemption under CWA §402(o)(2)(B)(i). The changes in the effluent limitations are based on the collection and statistical analysis of new information and, where the limitations increased or showed no reasonable potential and are no longer necessary, these changes are permissible per 18 AAC 83.135(b)(2).

CWA §303(d)(4)(A) states that, for waterbodies where the water quality does not meet applicable WQS, effluent limitations may be revised under two conditions: the revised effluent limitation must ensure the attainment of the WQS (based on the waterbody TMDL or the waste load allocation) or the designated use which is not being attained is removed in accordance with the WQS regulations. Since the applicable waterbodies are not impaired and do not have a TMDL, further evaluation under this provision is not required.

CWA §303(d)(4)(B) states that, for waterbodies where the water quality meets or exceeds the

level necessary to support the waterbody's designated uses, WQBELs may be revised as long as the revision is consistent with the State's Antidegradation Policy. Even if the requirements of CWA §303(d)(4) or 18 AAC 83.480(b) are satisfied, 18 AAC 83.480(c) and CWA §402(o)(3) prohibits relaxed limits that would result in violations of WQS or ELGs. Since the receiving water meets WQS to support designated uses and ELGs are applied via the permitting action, further evaluation under this provision is not required.

Since the previous permit was reissued, new information has been collected to characterize the effluent. An analysis of effluent water quality data resulted in changes to effluent limits. The reasonable potential analysis demonstrated that limits on antimony, arsenic, chromium, fluoride, manganese, nickel, sulfate, and total dissolved solids could be removed because there was no reasonable potential to exceed WQS. Effluent data also showed that the daily maximum limit for lead could be relaxed.

Conversely, the Department determined that some parameters required more stringent limits to ensure compliance with WQS and ELGs. Limits that are more stringent in the permit, in comparison to the previous permit, include: the average monthly limit for cadmium, copper, cyanide, lead, mercury, and zinc while the maximum daily limit for cadmium, copper, mercury, and zinc.

7.0 ANTIDEGRADATION

Section 303(d)(4) of the CWA states that, for waterbodies where the water quality meets or exceeds the level necessary to support the waterbody's designated uses, WQBELs may be revised as long as the revision is consistent with the State's Antidegradation Policy.

The Antidegradation Policy of the WQS (18 AAC 70.015) states that the existing water uses and the level of water quality necessary to protect existing uses must be maintained and protected. This section analyzes and provides rationale for the Department's decisions in the permit issuance with respect to the Antidegradation Policy.

The Department's approach to implementing the Antidegradation Policy, found in 18 AAC 70.015, is currently based on the Department's *Policy and Procedure Guidance for Interim Antidegradation Implementation Methods (Interim Methods)*, dated July 14, 2010. Note that the Lieutenant Governor signed and filed Antidegradation Implementation Methods regulations on March 7, 2018 with an effective date of April 6, 2018. The regulations were subsequently submitted to EPA on March 9, 2018 for review and approval. The new regulations may not be used for CWA purposes (e.g., APDES permits) until EPA approves the regulations for use in such purposes. As such, until the new regulations are approved by EPA for use in APDES permitting, the existing *Interim Methods* will be used in conjunction with the application of the Antidegradation Policy.

Using these requirements and policies, the Department determines whether a waterbody, or portion of a waterbody, is classified as Tier 1, Tier 2, or Tier 3, where a higher numbered tier indicates a greater level of water quality protection. At this time, no Tier 3 waters have been designated in Alaska. Accordingly, this antidegradation analysis conservatively assumes that the discharge is to a Tier 2 water, which is the next highest level of protection and is more rigorous than a Tier 1 analysis.

The State's Antidegradation Policy in 18 AAC 70.015(a)(2) states that if the quality of water exceeds levels necessary to support propagation of fish, shellfish, and wildlife and recreation in

and on the water (i.e., Tier 2 waters), that quality must be maintained and protected. The Department may allow a reduction of water quality only after finding that five specific requirements of the Antidegradation Policy at 18 AAC 70.015(a)(2)(A)-(E) are met. The Department's findings follow.

1) **18 AAC 70.015(a)(2)(A).** Allowing the discharge is necessary to accommodate important economic or social development in the area where the water is located.

   Based on the evaluation required per 18 AAC 70.0015(a)(2)(D) below, the Department has determined that the most reasonable and effective pollution prevention, control, and treatment methods are being used and that the localized lowering of water quality is necessary.

   Fort Knox has a significant impact on the socioeconomics of the Fairbanks North Star Borough (FNSB), as well as the state as a whole. Fort Knox employed more than 637 employees in 2014, all residing in the FNSB. Payroll in 2014 was $66.6 million, averaging $104,609 per employee (compensation package of wages and benefits). Fort Knox employee wages are approximately 2.3 times higher than the average income of private sector workers in FNSB.

   Fort Knox spent $206.8 million with approximately 424 private sector vendors in Alaska in 2014, representing 72 percent of its total annual spending.

   Fort Knox is the largest taxpayer in FNSB paying $6.9 million in real and business property taxes in 2014. The State of Alaska received $17.1 million in taxes and fees from Fort Knox, including $7.3 million in mining license tax.

   In 2014, Fort Knox contributed $340,000 to the Mining Engineering Research Endowment at the University of Alaska Fairbanks and has given nearly $3 million to the university. About 150 nonprofit community organizations received charitable contributions from FGMI. These organizations represented membership groups, charitable programs, youth sports, public safety support, social assistance, and civic organizations.

   The Department concludes that the operation of Fort Knox is important to the FNSB and Alaska, and contributes significantly to the socioeconomic health of many communities. The Department finds that the discharge is necessary to accommodate important economic and social development in the area where the water is located, and the requirement is met.

2) **18 AAC 70.015(a)(2)(B).** Except as allowed under this subsection, reducing water quality will not violate the applicable criteria of 18 AAC 70.020 or 18 AAC 70.235 or the WET limit in 18 AAC 70.030.

   Discharges authorized by the permit at outfalls 001 and 002 conform to the requirements of 18 AAC 70.020, 18 AAC 70.235, and 18 AAC 70.030. No mixing zone is authorized, and WQS are met at the end-of-pipe before the discharge enters the Old Fish Creek Channel or North Channel. More specifically, the permit's effluent limits are based on the applicable WQS (18 AAC 70.020) and converted to maximum daily and average monthly values using established calculations on actual effluent water quality data.

   The Department finds that the reduced water quality will not violate applicable water quality criteria 18 AAC 70.020, 18 AAC 70.235, or 18 AAC 70.030, and the requirement is met.

3) **18 AAC 70.015(a)(2)(C).** Resulting water quality will be adequate to fully protect existing

uses of the water.

In Technical Report No. 17-10, *Fish and Water Quality Monitoring at the Fort Knox Mine, 2017*, Alaska Department of Fish and Game found the following, "Dissolved oxygen (DO) concentrations were measured in mid-April 2017 and for the third consecutive year DO concentrations were some of the highest seen since sampling began in 1998. Higher DO concentrations appear to be directly related to the discharge of non-contact mine water to the water supply reservoir." The resulting water quality will not only protect existing uses, but enhancement of the existing fishery is indicated by recent data. In addition, no mixing zone or other water quality variance is being authorized.

DEC determined that wastewater treatment will result in adequate water quality to fully protect existing uses of the waterbody and that the finding is met.

4) **18 AAC 70.015(a)(2)(D).** The methods of pollution prevention, control, and treatment found by the Department to be most effective and reasonable will be applied to all wastes and other substances to be discharged.

   The Department finds the most effective methods of prevention, control, and treatment are the practices and requirements set out in the permit and currently in use for both outfalls at this mine. The Permittee is required to implement a Best Management Practices (BMP) plan. The BMP Plan includes pollution prevention measures and controls appropriate for each facility and discharge. The design, construction, and performance of the water treatment plants has also been reviewed and approved by the Department, consistent with 18 AAC 72.

   The final effluent must meet WQBELs before discharge. Consequently, only high quality water is permitted to be discharged. RO treatment of wastewater produces a high quality effluent, which easily meets WQS, as indicated by high quality reported effluent data.

   The Department finds that this criterion to address pollution prevention, control, and treatment is met.

5) **18 AAC 70.015(a)(2)(E).** All wastes and other substances discharged will be treated and controlled to achieve (i) for new and existing point sources, the highest statutory and regulatory requirements; and (ii) for nonpoint sources, all cost-effective and reasonable best management practices.

   The "highest statutory and regulatory requirements" defined in 18 AAC 70.990(30) (as amended June 26, 2003) have been applied to outfalls 001 and 002. There are three parts to the definition.

   The first part of the definition under 18 AAC 70.990(30)(A) considers all federal technology-based ELGs. For both outfalls, all applicable ELGs have been incorporated into the permit. Therefore, the Department concludes that this requirement is met.

   The second part of the definition under 18 AAC 70.990(30)(B) appears to be in error as 18 AAC 72.040 describes discharges to sewers and not minimum treatment. The correct reference appears to be the minimum treatment standards found at 18 AAC 72.050, which refers to domestic wastewater discharges only. Nonetheless, 18 AAC 72.050, Minimum Treatment, establishes minimum treatment requirements for domestic wastewater, and there are no domestic waste streams associated with this discharge.

The third part of "highest statutory and regulatory requirements" considers any more stringent treatment required by state law including 18 AAC 70 and 18 AAC 72. The correct operation of equipment, visual monitoring, and implementing BMPs, as well as other permit requirements, will control the discharge and satisfy all applicable federal and state requirements. The Department concludes that all wastes and other substances discharged will be treated and controlled to achieve the highest statutory and regulatory requirements and finds that this finding is met.

8.0 OTHER PERMIT CONDITIONS

8.1 Quality Assurance Project Plan

The Permittee is required to develop procedures in a Quality Assurance Project Plan (QAPP) to ensure that the monitoring data submitted are accurate and to explain data anomalies if they occur. The Permittee is required to update the QAPP and submit written notification of any updates to the Department within 60 days of the effective date of the final permit. The QAPP shall consist of standard operating procedures the Permittee must follow for collecting, handling, storing and shipping samples; laboratory analysis; and data reporting. The QAPP shall be retained on site and made available to the Department upon request.

8.2 Best Management Practices Plan

According to AS 46.03.110(d), as previously cited, the Department may specify in a permit the terms and conditions under which waste material may be disposed. This permit requires the Permittee to develop a Best Management Practices (BMP) Plan in order to prevent or minimize the potential for the release of pollutants to waters and lands of the State of Alaska through facility runoff, spillage or leaks, or erosion. The permit contains conditions that must be included in the BMP Plan. The permit requires the Permittee to update and implement its BMP Plan within 60 days of the effective date of the permit, the BMP Plan must be kept on site and made available to the Department upon request, the BMP Plan must be reviewed annually for compliance with permit requirements, and a statement must be submitted to the Department certifying each annual review.

8.3 Standard Conditions

Appendix A of the permit contains standard regulatory language that must be included in all APDES permits. These requirements are based on the regulations and cannot be challenged in the context of an individual APDES permit action. The standard regulatory language covers requirements such as monitoring, recording, reporting requirements, compliance responsibilities, general requirements, and other legal obligations.

9.0 OTHER CONSIDERATIONS

9.1 Endangered Species Act

The Endangered Species Act (ESA) requires federal agencies to consult with the National Oceanic and Atmospheric Administration National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (USFWS) if their actions could beneficially or adversely affect any threatened or endangered species. As a state agency, DEC is not required to consult with USFWS or NMFS regarding permitting actions. However, DEC values input

from the Services on ESA concerns, and on February 14, 2018, DEC solicited USFWS and NMFS for feedback about ESA impacts associated with this permit. That same day, USFWS indicated lack of concern about this permit because there are no threatened or endangered or species in the area of Fort Knox Mine (Bob Henszey, Fish & Wildlife Biologist, Fairbanks, personal communication). To date, NMFS has not yet responded to inquiries about ESA impacts.

9.2 Essential Fish Habitat

The Magnuson-Stevens Fishery Conservation and Management Act (January 21, 1999) requires federal agencies to consult with NMFS when any activity proposed to be permitted, funded, or undertaken by a federal agency has the potential to adversely affect (reduce quality and/or quantity of) Essential Fish Habitat (EFH). EFH includes the waters and substrate (sediments, etc.) necessary for fish from commercially-fished species to spawn, breed, feed, or grow to maturity. As a state agency, DEC is not required to consult with NMFS regarding permitting actions. However, DEC is concerned with protecting EFH, and on February 14, 2014, DEC solicited NMFS and ADF&G for feedback on EFH impacts associated with this permit. Later that day, ADF&G replied that only positive impacts to EFH are associated with the permitted activities (Parker Bradley, Habitat Biologist, Fairbanks, personal communication). To date, NMFS has not yet responded to inquiries about EFH impacts.

10.0 PERMIT EXPIRATION

The permit will expire five years from its effective date. Should the permit expire prior to the Department reissuing in a timely manner, the permit may be administratively continued under 18 AAC 83.155 if all requirements of this regulation are met.

11.0 REFERENCES

DEC (Alaska Department of Environmental Conservation). 2003. 18 AAC 70, Water Quality Standards. State of Alaska, Department of Environmental Conservation, June 26, 2003.

DEC. 2008. 18 AAC 70, Alaska Water Quality Criteria Manual for Toxic and Other Deleterious Organic and Inorganic Substances. State of Alaska, Department of Environmental Conservation, December 12, 2008.

DEC. 2010a. Interim Antidegradation Implementation Methods, Effective July 14, 2010. State of Alaska, Department of Environmental Conservation, Policy and Procedure No. 05.03.103.

DEC. 2010b. Alaska's Final 2010 Integrated Water Quality Monitoring and Assessment Report, July 15, 2010.

DEC. 2017a. 18 AAC 70, Water Quality Standards. State of Alaska, Department of Environmental Conservation, February 5, 2017.

DEC. 2017b. 18 AAC 72, Wastewater Disposal. State of Alaska, Department of Environmental Conservation, November 7, 2017.

DEC. 2017c. 18 AAC 83, Alaska Pollutant Discharge Elimination System. State of Alaska, Department of Environmental Conservation, November 7, 2017.

EPA (U.S. Environmental Protection Agency). 1991. Technical Support Document for Water Quality-based Toxics Control. Office of Water Enforcement and Permits, Office of Water Regulations and Standards, Washington, DC, March 1991, EPA/505/2-90-001.

EPA. 1993. Guidance Manual for Developing Best Management Practices (BMP). Office of Water, October 1993, EPA 833-B-93-004.

EPA. 1996. The Metals Translator: Guidance for Calculation a Total Recoverable Permit Limit from a Dissolved Criterion. June 1996. EPA 823-B-96-007.

EPA. 1998. Memo on total vs. total recoverable metals from W. Telliard dated August 19, 1998.

EPA. 2010. NPDES Permit Writer's Manual. EPA, Office of Wastewater Management, Water Permits Division, State and Regional Branch. Washington, DC. September 2010. EPA-833-K-10-001.

McDowell Group. 2015. Socioeconomic Impacts of the Fort Knox Mine, Summary of Findings. October 2015.

United States Geological Survey (USGS). Resource Data File Open-File Report 01-426.

APPENDIX A FACILITY INFORMATION

Figure 1: Vicinity Project Map

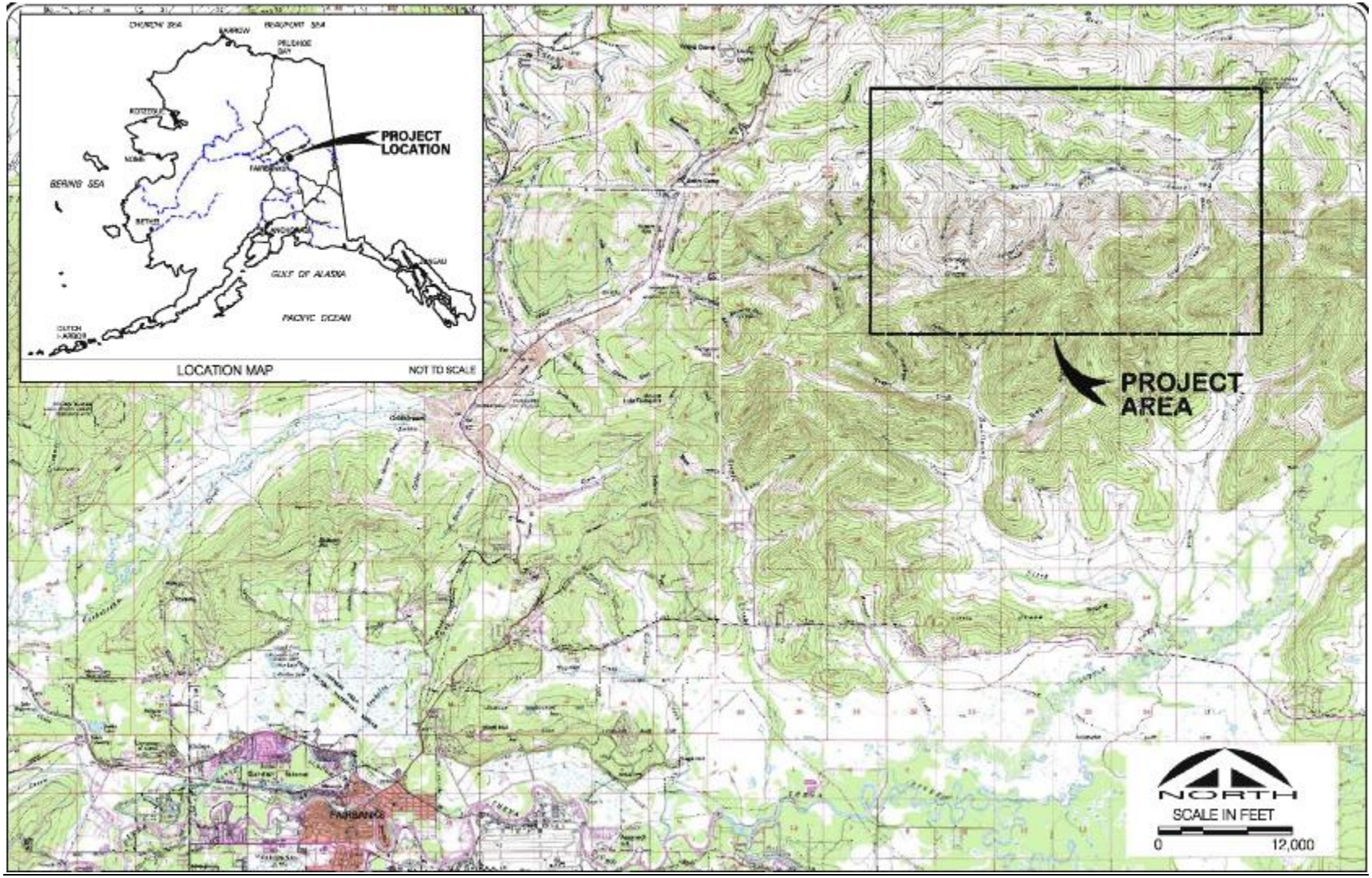


Figure 2: Site Map

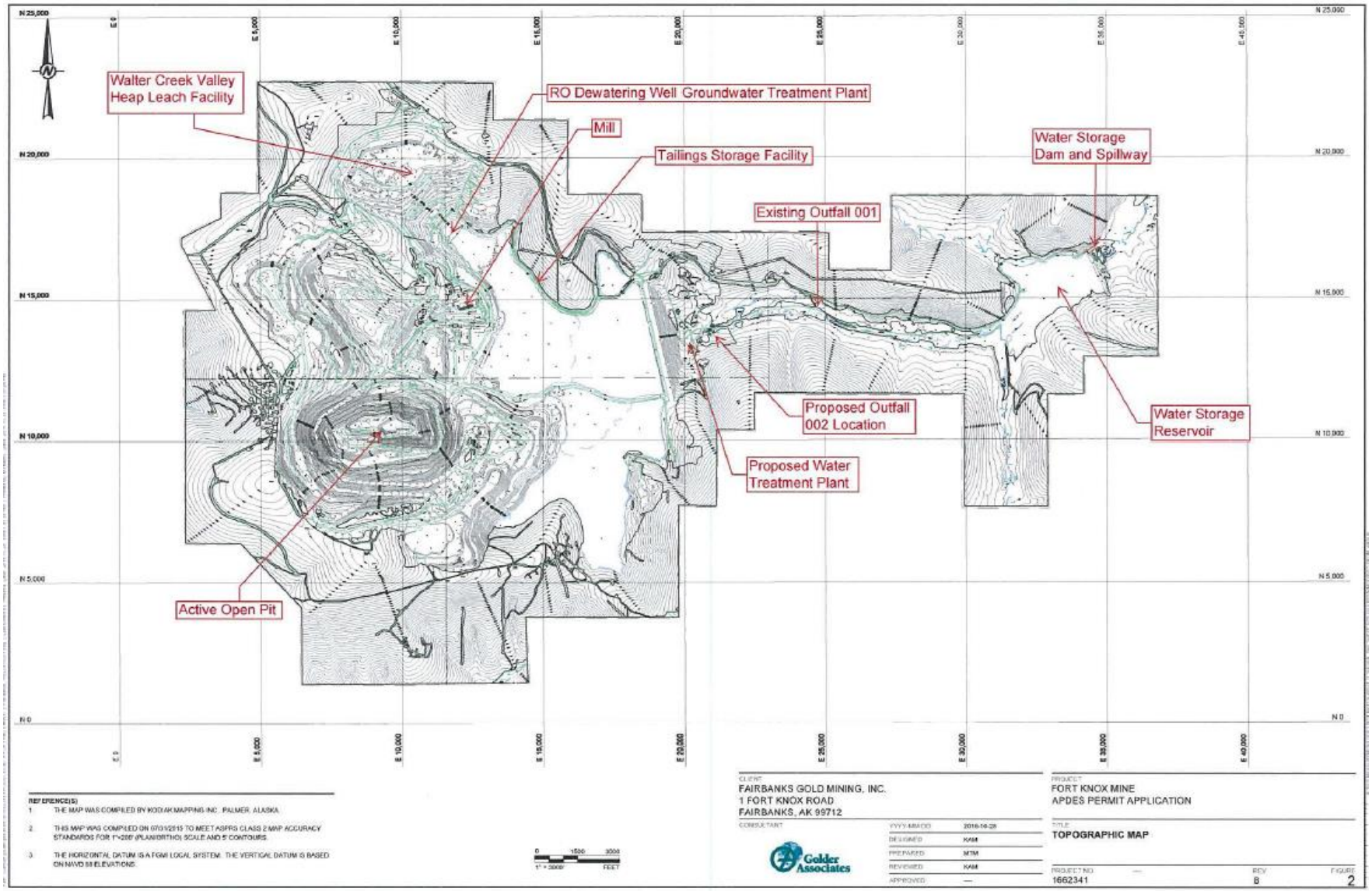
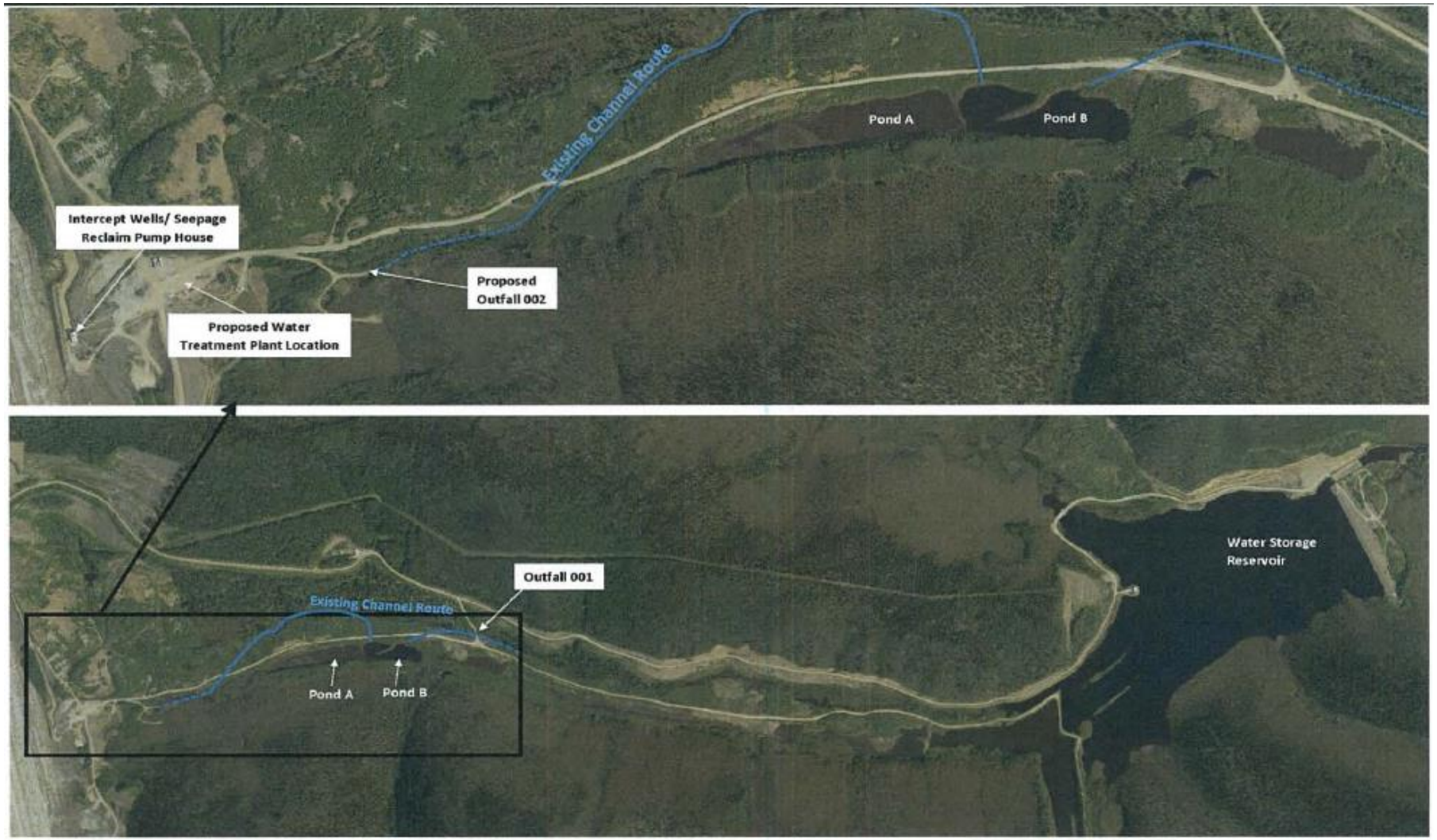


Figure 3: Outfall Sites



APPENDIX B BASIS FOR EFFLUENT LIMITS

This section discusses the basis for and the development of effluent limits in the permit. It is organized as follows: an overall discussion of the statutory and regulatory basis for development of effluent limitations (Section B-I); discussions of the development of technology-based effluent limits (Section B-II), water quality-based effluent limits (Section B-III); and a summary of the effluent limits (Section B-IV).

B-I Statutory and Regulatory Basis for Limits

Sections 101, 301(b), 304, 308, 401, 402, and 405 of the Clean Water Act (CWA) provide the federal statutory basis for the effluent limitations and other conditions in the permit. The Department evaluates the discharges with respect to these sections of the CWA and the relevant Alaska Pollutant Discharge Elimination System (APDES) regulations (18 AAC 83) to determine which conditions to include in the permit.

In general, the Department first determines if any federally-promulgated technology-based effluent limits have been developed that must be considered. The Department then evaluates the effluent quality expected to result from the technology-based controls to see if the discharge could result in any exceedances of the Alaska Water Quality Standards (WQS) in the receiving water. If reasonable potential exists that exceedances could occur, the Alaska Department of Environmental Conservation (DEC or the Department) must include water quality-based effluent limits in the permit. The permit limits reflect whichever requirements (technology-based or water quality-based) are more stringent.

B-II Technology-Based Evaluation

Section 301(b) of the CWA requires industrial dischargers to meet technology-based effluent limitation guidelines (ELGs) established by the Environmental Protection Agency (EPA) and adopted by reference in 18 AAC 83.010. These technology-based standards are enforceable through their incorporation into an APDES permit. Direct dischargers that are new sources must meet New Source Performance Standards (NSPS), which are based on the best available demonstrated control technology. NSPS apply to a source that has commenced construction after the ELGs were established and, as such, are directly applicable to the discharge of treated mine drainage and contact water from outfalls 001 and 002 at Fort Knox Mine.
In 40 CFR Part 440 Subpart J, EPA established ELGs for the Copper, Lead, Zinc, Gold, Silver, and Molybdenum Ores point source category. These ELGs apply NSPS to a new source mine, which is a source that has commenced construction after the ELGs were established on December 3, 1982. The NSPS that apply to Fort Knox Mine are shown in B- 1.

Table B- 1: Technology-Based Effluent Limits for Outfalls 001 and 002

Parameter	Units	Maximum for any 1 day	Average of daily values for 30 consecutive days
cadmium	mg/L[a]	0.10	0.05
copper	mg/L	0.30	0.15
lead	mg/L	0.6	0.3
mercury	mg/L	0.002	0.001
zinc	mg/L	1.5	0.75
pH	s.u.[b]	6.0 to 9.0	
total suspended solids (TSS)	mg/L	30.0	20.0
flow[c]	billion gallons per year	3.164	

a. milligrams per liter
b. standard units
c. Combined flow from both outfalls equaling the average annual net precipitation contributing to the treatment facility plus average annual mine dewatering groundwater and mine drainage volumes

B-III Water Quality-Based Evaluation

In addition to the technology-based effluent limits discussed above, the Department evaluated Fort Knox Mine discharges to determine compliance with Section 301(b)(1)(C) of the CWA. This section requires permit limits necessary to meet WQS.

Under 18 AAC 83.435, the Department must implement Section 301(b)(1)(C) of the CWA. It requires that APDES permits include limits for all pollutants or parameters which "are or may be discharged at a level which will cause, have the reasonable potential to cause, or contribute to an excursion above any state WQS, including state narrative criteria for water quality." The limits must be stringent enough to ensure that WQS are met and must be consistent with any available wasteload allocation (WLA).

To determine if water quality-based effluent limits (WQBEL) are needed and develop those limits when necessary, the Department follows guidance in the *APDES Permits Reasonable Potential Analysis and Effluent Limits Development Guide* (RPA Guidance, 2014). The water quality-based analysis consists of the following three step sequence:

1. Identify the applicable water quality criteria (see Section B-III.A);
2. Determine if there is "reasonable potential" for the discharge to exceed a water quality criterion in the receiving water (see Section B-III.B); and,
3. If there is "reasonable potential" or where a parameter has a technology-based limit and it requires dilution to meet WQS, develop effluent limits based on the WLA (see Section B-III.C).

The following sections provide a detailed discussion of each step.

B-III.A Water Quality Criteria

The first step in determining if WQBELs are needed is to identify the applicable water quality criteria. Alaska's WQS are found at 18 AAC 70. The applicable criteria are determined based on the beneficial uses of the receiving water.

The beneficial uses for the Old Fish Creek Channel, North Channel, and freshwater reservoir, the receiving water of outfalls 001 and 002, and the regulatory citation for the water quality criteria applicable to the uses are as follows:

1. domestic water supply – 18 AAC 70.020(b)(1)(A)(i)
2. agriculture water supply – 18 AAC 70.020(b)(1)(A)(ii)
3. aquaculture water supply – 18 AAC 70.020(b)(1)(A)(iii)
4. industrial uses – 18 AAC 70.020(b)(1)(A)(iv)
5. contact recreation – 18 AAC 70.020(b)(1)(B)(i)
6. secondary recreation – 18 AAC 70.020(b)(1)(B)(ii)
7. growth and propagation of fish, shellfish, other aquatic life, and wildlife – 18 AAC 70.020(b)(1)(C)

For a given pollutant, different uses may have different criteria. To protect all beneficial uses, the reasonable potential analysis and permit limits are based on the most stringent water quality criteria for protecting those uses. For the Old Fish Creek Channel and North Channel, the most stringent applicable criteria are summarized in Table B- 2.

Table B- 2: Most Stringent Applicable Water Quality Criteria

Parameter[a] (µg/L unless otherwise noted)	Acute	Chronic	
	Aquatic Life Criterion	Aquatic Life Criterion	Human Health Criterion
aluminum	750	750[b]	NA
ammonia as N (mg/L)	15.9	3.4	NA
antimony	NA	NA	6
arsenic	340	150	10
barium	NA	NA	2,000
cadmium[c]	1.3	0.19	5.0
chromium, total	NA	NA	100
copper[c]	8.7	6.0	200
cyanide, weak acid dissociable (WAD)	22	5.2	200
fluoride	NA	NA	1,000
iron	NA	1,000	5,000
lead[c]	43	1.7	50
manganese	NA	NA	50
mercury	2.4	0.012	0.05
nickel[c]	305	34	200
nitrite + nitrate as N	NA	NA	10,000
pH	within the range of 6.5 – 8.5		
selenium	20	5	10
silver	1.6	NA	NA
sulfate	NA	NA	250
total dissolved solids	NA	NA	500
zinc[c]	78	78	2,000

a. Criteria for metals have been converted to total recoverable.
b. Based on receiving water hardness greater than or equal to 50 mg/L as $CaCO_3$ and pH greater than or equal to 7.0
c. Hardness-based limits using a hardness of 60.2 mg/L $CaCO_3$, the 15th percentile of background data.

B-III.B Reasonable Potential Analysis

This section discusses how reasonable potential was evaluated for outfalls 001 and 002. For each parameter, the Department compared the maximum projected concentration to the criteria for that pollutant to determine if there is "reasonable potential" to cause or contribute to an exceedance of a water quality criterion for each pollutant present in the discharge. If the projected concentration exceeds a criterion, there is "reasonable potential," and a limit must be included in the permit. The Department used the recommendations in

the *RPA Guidance* to conduct the reasonable potential analysis.

For a given parameter discharged from outfall 001, the maximum expected effluent concentration was compared to the most stringent applicable water quality criterion.

C_e (Maximum expected effluent concentration or MEC): The maximum expected effluent concentration was calculated using the statistical approach recommended in Section 2.4 of the *RPA Guidance*. In this approach, a maximum expected effluent concentration is derived by multiplying the maximum observed effluent concentration by a reasonable potential multiplier (RPM):

C_e = MEC = (maximum observed effluent concentration) x RPM

The RPM accounts for uncertainty in the effluent data. The RPM depends upon the amount of effluent data, the statistical distribution assigned to the data, and the variability of the data as measured by the coefficient of variation (CV). Effluent data for each pollutant of concern was analyzed in ProUCL—a statistical software package developed under the direction of EPA—and the statistical distributions and corresponding CVs that best fit the data were selected.

There are three equations in the *RPA Guidance* for calculating the RPM. Each equation is valid for certain statistical distributions or sample populations. These three equations—with the citation to the Section in the *RPA Guidance* in which they appear are:

Equation 2.4.1.1 (RPM for Small or Insufficient Data Sets)

$$\text{RPM} = \frac{\exp(z_{99}\hat{\sigma} - 0.5\hat{\sigma}^2)}{\exp(p_n\hat{\sigma} - 0.5\hat{\sigma}^2)}$$

Where,

z_{99} = z-statistic at the 99th percentile = 2.326
$\hat{\sigma}$ = $[\ln(CV^2 + 1)]^{1/2}$
$\hat{\sigma}^2$ = $\ln(CV^2 + 1)$
CV = coefficient of variation (generally assumed to be 0.6 for small data sets)
p_n = z-statistic at the 95 percent confidence level = $(1\text{-}0.95)^{(1/n)}$
n = number of valid samples

Equation 2.4.2.1 (RPM for Normal, Non-Parametric, or Gamma Statistical Distributions)

$$\text{RPM} = \frac{\exp(\hat{\mu}_n + z_{99}\hat{\sigma})}{\exp(\hat{\mu}_n + p_n\hat{\sigma})}$$

Where,

$\hat{\mu}_n$ = the mean calculated by ProUCL
$\hat{\sigma}$ = standard deviation calculated by ProUCL

Equation 2.4.2.2 (RPM for Lognormal or Log-ROS Statistical Distributions)

$$\text{RPM} = \frac{\exp(z_{99}\hat{\sigma}_y - 0.5\hat{\sigma}_y{}^2)}{\exp(p_n\hat{\sigma}_y - 0.5\hat{\sigma}_y{}^2)}$$

Where,

$\hat{\sigma}_y$ = lognormal standard deviation calculated by ProUCL

$\hat{\sigma}_y^{\,2} =$ lognormal variance (square of the standard deviation calculated by ProUCL)

Table B-3 shows the assigned statistical distribution, references the equation used to calculate the RPM, and lists the calculated RPM for each parameter at Outfall 001.

Table B- 3: RPM Calculation for Outfalls 001 and 002

Parameter	Statistical Distribution	Equation	RPM
aluminum	normal	2.4.2.1	1.54
ammonia as N	normal	2.4.2.1	1.33
antimony	normal	2.4.2.1	1.13
arsenic	normal	2.4.2.1	1.10
barium	normal	2.4.2.1	1.45
cadmium	NA (default coefficient of variation at 0.6)	2.4.1.1	9.04
chromium, total	normal	2.4.2.1	1.03
copper	normal	2.4.2.1	1.18
cyanide, WAD	normal	2.4.2.1	1.20
fluoride	normal	2.4.2.1	1.09
iron	normal	2.4.2.1	1.42
lead	normal	2.4.2.1	1.19
manganese	normal	2.4.2.1	1.13
mercury	NA (default coefficient of variation at 0.6)	2.4.1.1	9.04
nickel	normal	2.4.2.1	1.10
nitrite + nitrate as N	normal	2.4.2.1	1.09
selenium	normal	2.4.2.1	1.77
silver	NA (all data non-detect)	2.4.2.1	1.00
sulfate	normal	2.4.2.1	1.09
total dissolved solids	normal	2.4.2.1	1.09

Parameter	Statistical Distribution	Equation	RPM
zinc	normal	2.4.2.1	1.14

Reasonable Potential Summary: The reasonable potential analysis covers only parameters without a mixing zone. Parameters without a mixing zone receive no dilution, and consequently, the reasonable potential analysis focuses on the reverse osmosis (RO) effluent data as shown in Table B- 4.

Table B- 4: Reasonable Potential Determination at the End-of-Pipe

Parameter[a] (µg/L unless otherwise noted)	Effluent Data when the influent is Well Water					Most Stringent Water Quality Criterion[c]	Reasonable Potential (yes or no)
	Max Observed Effluent Conc.	Number of Samples	Coefficient of Variation (CV)	Reasonable Potential Multiplier (RPM)	Max Expected Effluent Conc. (MEC)[b]		
antimony	1.21	96	0.571	1.13	1.36	6.0	no
arsenic	5.41	96	0.368	1.10	5.95	10	no
cadmium	100	1	0.600	9.04	904	0.19	yes
chromium, total	0.80	97	0.0635	1.03	0.82	100	no
copper	1.90	96	1.39	1.18	2.23	6.0	no
cyanide, WAD	46.5	96	2.33	1.20	55.7	5.2	yes
fluoride	0.34	96	1.66	1.09	0.371	1,000	no
lead	0.750	96	1.55	1.19	0.896	1.7	no
manganese	17.1	96	0.400	1.13	19.2	50	no
mercury	2.00	1	0.600	9.04	18.1	0.012	yes
nickel	0.600	96	0.380	1.10	0.661	34	no
nitrite + nitrate as N	1.64	96	0.341	1.09	1.80	10,000	no
sulfate (mg/L)	60.5	96	0.317	1.09	66.0	250	no
total dissolved solids (mg/L)	287	96	0.330	1.09	314	500	no
zinc	78.8	122	1.90	1.14	89.9	78	yes

a. Criteria for metals have been converted to total recoverable.
b. For each parameter, the MEC equals the maximum observed effluent concentration times the RPM producing a number based on water treatment plant performance, which was used to determine if there is a reasonable potential for the effluent to exceed WQS.
c. From Table B- 2

RO effluent data in Table B- 4 used well water as the influent. However, this permit includes the treatment and discharge of additional wastewater sources. Outfalls 001 and 002 will discharge treated wastewater from wells, dam seepage, and the tailings storage facility (TSF). Water quality data provided by the applicant shows that TSF water is poorer quality than seepage water. The RO treatment units, Osmo PRO-450-NA, used at Fort Knox have a nominal rejection rate (removal efficiency) of 97 to 99 percent.

The reasonable potential analysis in Table B- 5 conservatively assumes a RO rejection rate of 95 percent, which is half the published treatment efficiency for the systems being used, and looked at a wide array of pollutants to determine if TSF water will result in additional reasonable potential determinations. Since the reasonable potential analysis of the predicted RO-treated wastewater effluent does not indicate reasonable potential to exceed water quality criteria for the parameters of concern, identical monitoring requirements and effluent limits were established for both outfalls using the results of effluent data from outfall 001, which requires compliance with WQS prior to discharge.

Table B- 5: Reasonable Potential Determination on TSF Water Quality

Parameter[a] (µg/L unless otherwise noted)	Effluent Data when the Influent is only TSF Water					Most Stringent Water Quality Criterion[c]	Reasonable Potential (yes or no)
	Max Observed Effluent Conc.	Number of Samples	Coefficient of Variation (CV)	Reasonable Potential Multiplier (RPM)	Max Expected Effluent Conc. (MEC)[b]		
aluminum	313	20	0.818	1.54	481	750	no
ammonia as N (mg/L)	0.254	20	0.366	1.33	0.337	3.4	no
antimony	1.65	20	0.218	1.22	2.01	6	no
arsenic	4.88	20	0.622	1.46	7.13	10	no
barium	6.90	20	0.600	1.45	10.0	2,000	no
chloride (mg/L)	2.95	20	0.201	1.28	10.0	230	no
chromium (total)	0.250	20	0	1.00	3.78	100	no
fluoride	35.0	20	0.202	1.21	42.2	1,000	no
iron	63.0	20	0.528	1.42	89.3	1,000	no
manganese	7.20	20	0.343	1.31	9.43	50	no
nickel	1.00	20	0.517	1.41	1.41	34	no
nitrite + nitrate as N (mg/L)	1.12	20	0.176	1.18	1.33	10	no
selenium	1.95	20	1.92	1.77	3.46	5	no
silver	0.250	20	0	1.00	0.250	1.6	no
sulfate (mg/L)	9.25	20	0.162	1.17	10.8	250	no
total dissolved	27.5	20	0.114	1.13	31.0	500	no

Parameter[a] (µg/L unless otherwise noted)	Effluent Data when the Influent is only TSF Water					Most Stringent Water Quality Criterion[c]	Reasonable Potential (yes or no)
	Max Observed Effluent Conc.	Number of Samples	Coefficient of Variation (CV)	Reasonable Potential Multiplier (RPM)	Max Expected Effluent Conc. (MEC)[b]		
solids (mg/L)							

a. Criteria for metals have been converted to total recoverable.
b. For each parameter, the MEC equals the maximum observed effluent concentration times the RPM producing a number based on water treatment plant performance, which was used to determine if there is a reasonable potential for the effluent to exceed WQS.
c. From Table B- 2

B-III.C Water Quality–Based Effluent Limit Calculation

Once the Department determines that the effluent has a reasonable potential to exceed WQS or a parameter has a technology-based limit that exceeds WQS, a WQBEL for the pollutant is developed. Certain parameters found in outfall 001 were shown to have reasonable potential to exceed select WQS so WQBELs were developed. This section explains the procedure used to develop WQBELs.

The first step in calculating a permit limit is development of a WLA for the pollutant. The WLA is the concentration of the pollutant that may be discharged while still ensuring that the downstream water quality criterion is met.

WLAs

In the absence of dilution, the applicable water quality criterion becomes the WLA. Establishing the criterion as the WLA ensures that the Permittee's discharge does not contribute to an exceedance of the criterion. There may be up to three different WLAs for a given pollutant if there are acute, chronic, and human health water quality criteria for the pollutant. These WLAs include the acute WLA (WLA_{acute}) and chronic WLA ($WLA_{chronic}$).

Long Term Averages (LTAs)

Acute and chronic standards apply over different time frames; therefore, it is not possible to compare the WLAs directly to determine which standard results in the most stringent limits. The acute criteria are applied as a one-hour average and chronic criteria are applied as a four-day average. To allow for comparison of acute and chronic WLAs, long term average (LTA) loads are calculated from the acute and chronic WLAs. The most stringent LTA is used to calculate the permit limits.

Permit Limit Derivation

Once the appropriate LTA has been calculated, the Department applies the statistical approach described in Chapter 3 of the RPA Guidance to calculate maximum daily and average monthly permit limits. This approach takes into account effluent variability [using the Coefficient of Variation (CV)], sampling frequency, and the difference in time frames between the average monthly and maximum daily limits.

The maximum daily limit is based on the CV of the data and the probability basis, while the average monthly limit is dependent on these two variables and the monitoring frequency. As recommended in the RPA Guidance, the Department used a probability basis of 95 percent for average monthly limit calculation and 99 percent for the maximum daily limit calculation.

The following is a summary of the steps to derive WQBELs. Cyanide is used as an example.

Step 1- Determine the WLA

In this case, where there is no dilution, the acute and chronic aquatic life criteria become the WLAs. As shown in Table B- 2, the acute and chronic water quality criteria for cyanide are 22.0 and 5.2 µg/L, respectively. Accordingly, the WLAs are:

$WLA_{acute} = 22$ µg/L

$WLA_{chronic} = 5.2$ µg/L

Step 2 - Determine the Long-Term Average (LTA)

From Section 3.3 in the *RPA Guidance*,

$$LTA_{acute} = WLA_{acute} * e^{(0.5\sigma^2 - z_{99}\sigma)}$$

Where,

$\sigma^2 = \ln(CV^2 + 1)$

$\sigma^2 = \ln(2.33^2 + 1)$

$\sigma^2 = 1.86$

$z_{99} = 2.326$ for 99th percentile probability basis

$$\boldsymbol{LTA_{acute} = 2.33 \text{ µg/L}}$$

$$LTA_{chronic} = WLA_{chronic} * e^{(0.5\sigma_4{}^2 - z_{99}\sigma_4)}$$

Where,

$$\sigma_4{}^2 = \ln\left(\frac{CV^2}{4} + 1\right)$$

$$\sigma_4{}^2 = \ln\left(\frac{2.33^2}{4} + 1\right)$$

$\sigma_4{}^2 = 0.858$

$$\boldsymbol{LTA_{chronic} = 0.925 \text{ µg/L}}$$

Step 3 - Most Limiting LTA

To protect a waterbody from both acute and chronic effects, the most limiting of the calculated LTAs is used to derive the effluent limitations. $LTA_{chronic}$ is the most limiting LTA.

Step 4 - Calculate the Permit Limits

The *RPA Guidance* recommends using the 95th percentile for the Average Monthly Limit (AML) and the 99th percentile for the Maximum Daily Limit (MDL). The MDL and the AML for aquatic life are calculated as follows:

$$\text{MDL}_{aquatic} = LTA_{chronic} * e^{(z_{99}\sigma - 0.5\sigma^2)}$$

Where,

$\sigma_4{}^2 = 0.858$ (as previously calculated)

$$\boldsymbol{MDL_{aquatic} = 8.72\ \mu g/L}$$

$$\text{AML}_{aquatic} = LTA_{chronic} * e^{(z_{95}\sigma_n - 0.5{\sigma_n}^2)}$$

Where,

$${\sigma_n}^2 = \ln\left(\frac{CV^2}{n} + 1\right)$$

$${\sigma_n}^2 = \ln\left(\frac{2.33^2}{4} + 1\right)$$

${\sigma_n}^2 = 0.858$ (as previously calculated)

$z_{95} = 1.645$ for 95th percentile probability basis

n = number of sampling events per month for cyanide = 4

$$\boldsymbol{AML_{aquatic} = 2.77\ \mu g/L}$$

B-IV Summary of Permit Effluent Limitations

As discussed in Section B-I of this appendix, technology-based and water quality-based limits have been applied to the outfall 001 and 002 discharges. The following table offers outfall permit limits and their bases.

Table B- 6: Outfall 001 and 002 Effluent Limits

Parameter	Units	Daily Maximum		Monthly Average	
		Effluent Limit	Basis for Limit	Effluent Limit	Basis for Limit
cadmium	µg/L	0.31	Chronic WQS	0.15	Chronic WQS
copper	µg/L	8.7	Acute WQS	3.1	Acute WQS
cyanide, WAD	µg/L	8.7	Chronic WQS	2.8	Chronic WQS
lead	µg/L	2.9	Chronic WQS	0.92	Chronic WQS
mercury	µg/L	0.020	Chronic WQS	0.010	Chronic WQS
pH	s.u.	6.5 to 8.5			Chronic WQS
Total suspended solids	mg/L	30	TBEL	20	TBEL
Volume, cumulative	3.164 billion gallons per year as combined flow from both outfalls				TBEL
Zinc	µg/L	78	Acute WQS	26	Acute WQS